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ABSTRACT

Findings of a 1986 National Science Foundation survey of faculty and nonfaculty doctorates in 2,074 departments in 21 science and engineering (S/E) fields at 181 doctorate-granting institutions are summarized and compared to previous surveys. The proportion of recent-doctorate full-time faculty increased in each of the four engineering fields surveyed in 1980 and 1986, while the proportion either increased or remained constant for 7 of 15 science fields. In 1986, the largest percentage of recent doctorates was in computer science (40%), while the smallest proportion was in physics (11%). Many of the recent-doctorate faculty had foreign backgrounds. The proportions of female faculty increased in all fields. The greatest relative growth was in engineering; nonetheless, women comprised only 3% of total and 6% of recent-doctorate faculty in 1986. Women constituted 11% of total and 18% of recent-doctorate faculty in the science fields surveyed. The number of full-time black faculty increased; they comprised about 2% of recent-doctorate faculty in 1986. One-tenth of the recent-doctorate faculty in 1986 were Asian. (SW)

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SCIENCE RESOURCES STUDIES - HIGHLIGHTS

National Science Foundation Washington, D.C. 20550 July 24, 1987 NSF 87-310

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 JULY 24, 1987 NSF 87-310

Recent-Doctorate Faculty[1] Increase in Engineering and Some Science Fields

In spring 1986, the National Science Foundation (NSF) conducted a survey of faculty and nonfaculty doctorates in 2,074 departments in 21 science and engineering (S/E) fields at 181 doctorate-granting institutions. These institutions had received at least $2.15 million in Federal research and development funds in fiscal year (FY) 1983.[2] The universities involved in this survey constituted 56 percent of doctorate-granting institutions and accounted for 96 percent of R&D expenditures and 86 percent of the S/E graduate enrollment in 1985. The surveyed departments accounted for roughly 25 percent of the S/E graduate programs at doctorate-granting institutions.

The 1986 survey marked the continuation of surveys of faculty conducted in 1974 and 1980 at the same universe of institutions in a more limited number of fields. The 1974 survey included 1,633 departments in 15 fields and the 1980 survey included 1,866 departments in 19 fields. The trend findings are based on comparisons of the population estimates from the three surveys in the appropriate fields.

Highlights

- The proportion of recent-doctorate full-time faculty increased in each of the four engineering fields surveyed in 1980 and 1986, from an average of 20 percent to 25 percent. That proportion either increased or remained constant in 7 of 15 science fields. In 1986, the largest percentage of recent doctorates was reported in computer science (40 percent), while the smallest proportion was in physics (11 percent). On average, the engineering fields reported a larger proportion of recent doctorates than the science fields (25 percent compared to 20 percent).

- Many of the recent-doctorate faculty had foreign backgrounds. In 1986, the proportions of the assistant professors holding foreign baccalaureates ranged from 39 percent in electrical engineering departments to 30 percent in chemical engineering. In the science fields, comparable proportions ranged from 36 percent in computer science to 4 percent in psychology.

- The proportions of female faculty increased in all fields that were surveyed in both 1980 and 1986. The greatest relative growth was in engineering; nonetheless, women comprised only 3 percent of total and 6 percent of recent-doctorate faculty in 1986. Women constituted 11 percent of total and 18 percent of recent-doctorate faculty in the science fields surveyed. In both science and engineering, these shares were smaller than women's representation among recent-doctorate recipients.

- The number of full-time black faculty increased. In 1986, their share of faculty was about 1 percent. Blacks comprised about 2 percent of recent-doctorate faculty in 1986, comparable to their representation among recent-doctorate recipients.

- The percentages of Asian faculty increased in many fields, with the greatest growth in engineering. By 1986, Asians constituted, on average, 7 percent of the faculty in the departments surveyed. One-tenth of the recent-doctorate faculty in 1986 were Asian, a proportion higher than their share of recent-doctorate recipients (5 percent).

Introduction

Reversing a long-term trend, the proportion of faculty who received their doctorates within the last seven years (hereafter referred to as recent doctorates) increased or remained constant in 11 S/E fields between 1980 and 1986. In the next six years, further increases are likely as a growing proportion of faculty in all fields reach retirement age.

The 1980-86 period was one of overall growth in the number of faculty in the 19 S/E fields surveyed in both years. While the number of departments increased in many fields, faculty grew even more. Therefore, average department size expanded in most of the fields, with the largest increases in the engineering fields and computer science.

Compared to 1980, faculty in 1986 were more diverse in terms of gender, race, and ethnicity. Trend data on women and minority faculty indicate that their numbers and percentages generally grew. Still, women comprised a smaller share of faculty than they did of graduate students and recent-doctorate recipients in 1986; among minorities, only Asians constituted a larger share. Information on foreign faculty, collected in 1986 for the first time, suggests that they constituted shares of assistant professors comparable to their representation among graduate students and recent-doctorate recipients.

Recent-Doctorate Faculty

Between 1980 and 1986, the proportion of full-time recent-doctorate faculty increased in the engineering fields surveyed (table 1). In four of the science fields, the proportion of recent doctorates also increased, while in three fields it remained constant. These findings indicate a change in the trend observed

[1] Those who received their doctoral degrees within the last seven years, i.e., since 1978.

[2] This figure is the current-dollar equivalent of $1 million in constant 1972 dollars, the value used to determine the institutional universe for the 1974 survey.

Table 1. Full-time faculty, proportion with recent doctorates and aged 60 and over, in selected science/engineering departments: 1974, 1980, and 1986

Department	Total faculty			Percent of total				
				Recent doctorate faculty			Faculty aged 60 and over	
	1974	1980	1986	1974	1980	1986	1980	1986
ENGINEERING								
Aeronautical	NA	NA	540	NA	NA	25	NA	16
Chemical	970	1,050	1,230	21	22	26	10	12
Civil	NA	1,930	2,020	NA	22	25	8	12
Electrical	2,320	2,330	3,140	26	17	24	8	12
Industrial	NA	NA	550	NA	NA	29	NA	11
Mechanical	NA	2,060	2,310	NA	19	25	9	15
SCIENCE								
Chemistry	3,260	3,410	3,630	16	16	21	10	14
Physics	3,720	3,570	3,900	18	11	11	7	15
Geosciences	1,220	1,390	1,280	25	19	22	10	12
Mathematics	4,580	4,480	5,040	35	22	21	6	9
Computer science	NA	840	1,420	NA	38	40	2	5
Biochemistry	1,920	1,700	2,140	21	14	17	10	13
Biology	2,810	2,400	3,220	25	19	16	9	12
Botany	860	860	720	24	19	17	13	12
Microbiology	1,590	1,450	1,770	27	18	18	9	11
Physiology	1,550	1,450	1,780	30	22	18	8	10
Zoology	1,080	1,030	880	28	23	19	12	12
Psychology	3,380	3,410	3,510	38	27	21	7	11
Economics	2,420	2,550	2,660	35	30	30	9	10
Political science	NA	2,180	1,980	NA	26	20	10	13
Sociology	1,930	1,970	1,870	43	31	19	9	12

NOTE: NA: Not available.
SOURCE: National Science Foundation, SRS

between 1974 and 1980 in which the proportion of recent doctorates declined in 14 of 15 fields.

In 1986, there were 9,140 recent doctorates in faculty positions in the 2,074 departments surveyed.[3] One-quarter of the recent-doctorate faculty were in the 460 engineering departments surveyed. In fact, among departments in the four engineering fields included in the 1980 and 1986 surveys, the number of recent-doctorate faculty increased 47 percent. Over the same period, that number remained constant in the science departments surveyed.

About 25 percent of the full-time faculty within the engineering fields had received their doctorates within the last seven years, compared to an average of 20 percent for science fields. The percentages in specific fields ranged from 40 percent in computer science to 11 percent in physics.

Full-Time Faculty

The total number of full-time faculty in the 21 S/E fields surveyed in 1986 was 45,610.[4] In the 19 fields surveyed in both 1980 and 1986, the number of full-time faculty increased about 11 percent.

Part of the increase was attributable to a growing number of departments in the fields surveyed, up 8 percent since 1980. In three-quarters of the fields, the departmental population increased between 1980 and 1986, reversing the trend in 1974-80. In the last six years, the number of departments declined in only six fields: Geosciences, economics, political science, sociology, botany, and zoology. In the latter three fields, there were also declines between 1974 and 1980.

Average department size also increased in all but five fields: Chemistry, biology, zoology, psychology, and sociology. In general, the numbers of full-time departmental faculty in the S/E fields surveyed have been expanding since 1974, with the greatest growth in the engineering fields. Faculty in a sample of matched departments (included in both the 1980 and 1986 surveys) increased, on average, 14 percent in the engineering fields and 4 percent in the science fields.

Over the same period, the proportion of faculty in the older age categories (60 years and older) increased in almost all fields (table 1). The greatest increase was in the proportion of faculty over 65 years old, which doubled from 2 percent to 4 percent. The proportion of faculty aged 60 to 64 increased from 6 percent to 8 percent. The percentage of faculty aged 60 and older ranged from 16 percent in aeronautical engineering and 15 percent in physics to 11 percent in industrial engineering and 4 percent in computer science.

These figures suggest that up to 12 percent, or 5,500, of the current full-time S/E faculty in the departments surveyed may retire during the next five years. Among these departments, the largest number of retirements would be expected in civil and electrical engineering, and physics, mathematics, and economics. If vacancies are filled with recent doctorates, their share of faculty positions will increase over the next 6-year period.

[3] The reader is cautioned that these figures *do not* represent totals for S/E recent-doctorate faculty. They are totals only for the 21 fields at the 181 doctorate-granting institutions that constitute the survey domain.

[4] *Ibid.*

Foreign Participation

In response to concerns about the level of foreign participation in the U.S. academic sector, the 1986 survey collected information on faculty with non-U.S. baccalaureates and on faculty and doctorates in nonfaculty academic research positions with foreign citizenship. Although a majority of the faculty with foreign bachelor's degrees were also foreign citizens, these two groups were not identical.

The proportions of assistant professors with foreign baccalaureates ranged from 39 percent in electrical engineering to 4 percent in psychology. These foreign-trained junior faculty were distributed among the S/E fields in about the same relative proportions as foreign citizens were represented among graduate students and recent-doctorate recipients from American universities.

FULL-TIME FACULTY WITH NON-U.S. BACCALAUREATES

In 1986, 7,290 full-time faculty (16 percent) in the departments surveyed had received their baccalaureates at foreign institutions. In general, a greater proportion of faculty in the engineering fields were non-U.S. baccalaureates. Almost a quarter of the full-time faculty in mechanical engineering, and a fifth of those in civil and chemical engineering had foreign bachelor's degrees.

About 20 percent of all assistant professors surveyed held foreign bachelor's degrees, a proportion comparable to foreigners' share of recent-doctorate recipients (22 percent) and current graduate students (27 percent).[5] At least 30 percent of the assistant professors in each of the six engineering fields held non-U.S. baccalaureates. In the science fields, comparable proportions ranged from 36 percent in computer science to 4 percent in psychology (chart 1).

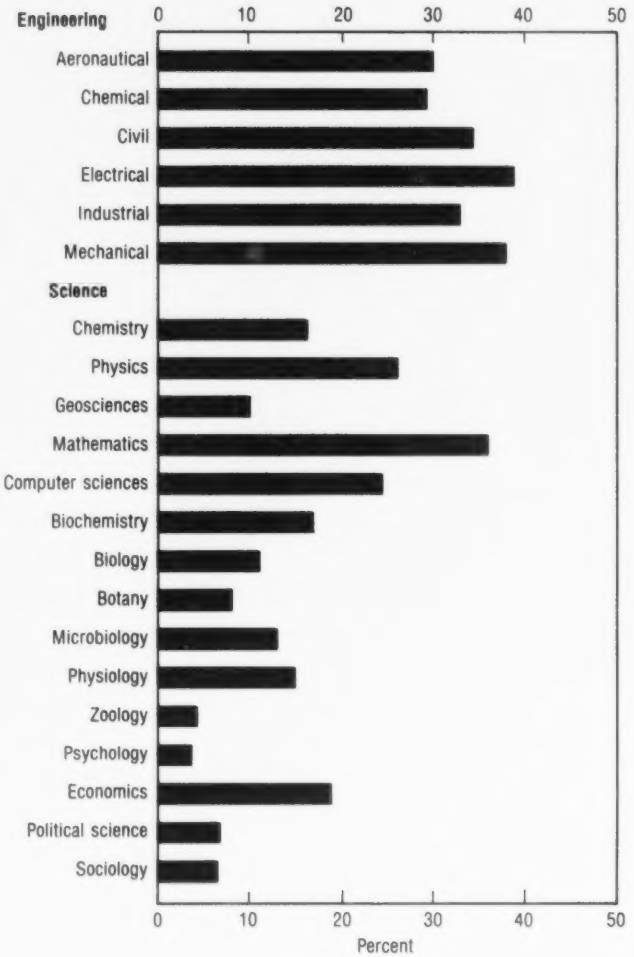
The data suggest that reliance on faculty with foreign bachelor's degrees is not new for American universities. In 1986, 15 percent of the full professors in the surveyed departments had non-U.S. baccalaureates. In fact, most of the faculty with foreign baccalaureates were full professors, in all fields except computer science and industrial engineering.

FOREIGN CITIZENS

In 1986, there were 4,870 foreign citizens in faculty and nonfaculty doctorate positions in the research universities surveyed. Of these, 3,210 were foreign citizens on permanent visas; another 1,660 were foreigners on temporary visas. Those on permanent visas comprised about 6 percent of faculty and nonfaculty doctorates (hereafter referred to as departmental staff), consistent with their share of recent-doctorate recipients. Foreigners on temporary visas comprised about 3 percent of departmental staff, much less than their share of the recent-doctorate recipients from American universities (17 percent, on average).[6]

In general, foreign citizen staff were concentrated in engineering and computer science departments. More than 10 percent of the faculty and nonfaculty doctorates in civil, industrial, and mechanical engineering and computer science were foreign citizens on permanent visas. Over 5 percent of the departmental staff in biochemistry and computer science were foreigners on temporary visas.

Chart 1. Full-time assistant professors with foreign baccalaureates in selected science/engineering departments: 1986



SOURCE: National Science Foundation, SRS

Women and Minorities

In almost all the S/E fields surveyed, the number and proportion of both female and minorities in faculty and nonfaculty doctorate positions increased between 1980 and 1986. This growth reflects changes in the labor market, affirmative action activities, and efforts to increase role models for an increasing number of women and minority undergraduate and graduate students. Nonetheless, women comprised a significantly smaller proportion of departmental staff than they did of graduate students and doctorate recipients. Among minorities, only Asians constituted a significantly higher proportion of academic positions than their share of graduate students and doctorate recipients would suggest.

WOMEN

The number of female faculty and nonfaculty doctorates increased about 38 percent between 1980 and 1986, from

[5] National Science Foundation, *Science and Engineering Doctorates: 1960-84*, 1986, and "Selected Data on Graduate S/E Students and Postdoctorates by Citizenship, 1985" (Washington, D.C., 1986.).

[6] Foreigners on temporary visas received 39 percent of the engineering doctorates granted between 1978 and 1984; they received 14 percent of the science doctorates granted during that period. National Science Foundation, *Science and Engineering Doctorates: 1960-84*, op. cit..

3,000 to 4,150 in the departments surveyed. The increase among recent doctorates was smaller than among senior-doctorate faculty (i.e., those who received their doctoral degrees before 1978); the latter increased 65 percent, whereas recent-doctorate faculty increased only 16 percent. Recent doctorates comprised 34 percent of the women faculty in 1986 compared to 41 percent in 1980.

Despite the growth in female faculty, women accounted for only 7 percent of the senior doctorates and 15 percent of the recent doctorates in 1986. In contrast, women accounted for almost a quarter of the nonfaculty doctorates in 1986, a share more comparable to their representation among recent-doctorate recipients (23 percent) and current graduate students (34 percent).[7]

Female doctorates remained more concentrated in the nonfaculty positions than males. Both in 1980 and 1986, about 20 percent of the female departmental staff were nonfaculty doctorates compared to only 8 percent of the males. In fact, the proportion of women nonfaculty doctorates increased to 23 percent from 18 percent in 1980. This concentration in nonfaculty positions, as well as the field distribution of female doctorates, may help explain why their median salary in academia remains roughly 80 percent of the median male salary.[8]

Focusing on specific fields, the number of female faculty in engineering more than doubled over the 6-year period. Nonetheless, in 1986, women accounted for less than 3 percent of the faculty in fields surveyed, except industrial engineering (chart 2). In the science fields, the largest proportions of female faculty were still in psychology, sociology, biology, microbiology, and physiology. Over a third of the nonfaculty doctorates in the life sciences were also women in 1986.

BLACKS

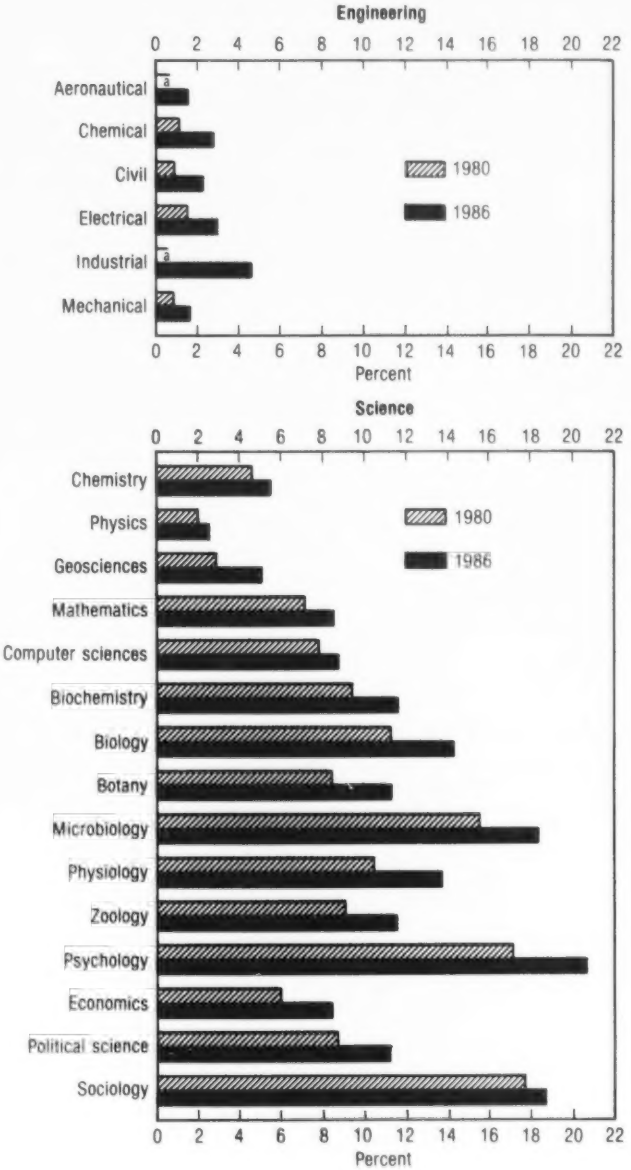
Overall, the number of black faculty in the S/E departments surveyed was 610, an increase of 40 percent between 1980 and 1986; black nonfaculty doctorates increased to 40. Both the number of black senior-doctorate faculty and nonfaculty doctorates doubled between 1980 and 1986. The number of black recent-doctorate faculty remained constant. In 1986, only 25 percent of the black faculty were recent doctorates compared to 39 percent in 1980.

Despite the growth in numbers, blacks constituted only 1 percent of the senior-doctorate faculty and nonfaculty doctorates in 1986. Their share of the recent-doctorate faculty (2 percent) was comparable to their representation among S/E graduate students and recent-doctorate recipients.[9]

Compared to other racial minorities, blacks were more likely to hold faculty rather than nonfaculty doctoral positions. In 1986, only 7 percent of the black departmental staff were non-faculty doctorates compared to 19 percent of the native Americans and 22 percent of the Asians.

Still the median salary of blacks employed at colleges and universities was lower than that of other minorities: $38,200 in 1985, compared to $40,200 for native Americans and $41,000 for Asians.[10] In part, the lower median salary may be attributable to the fact that blacks are concentrated in the relatively low-paid social and biological science fields. Over half the blacks surveyed were in these two areas (chart 3), and only 10 percent of the blacks were in the more highly paid engineering fields.

Chart 2. Female full-time faculty in selected science/engineering departments: 1980 and 1986



[a]Data not available in 1980.
SOURCE: National Science Foundation, SRS

ASIANS

Since 1980, Asian faculty overall increased 44 percent, totalling 3,080 in 1986. Asian nonfaculty doctorates remained constant at about 880. Recent-doctorate Asian faculty increased by twice as much as senior doctorates, by 68 percent compared

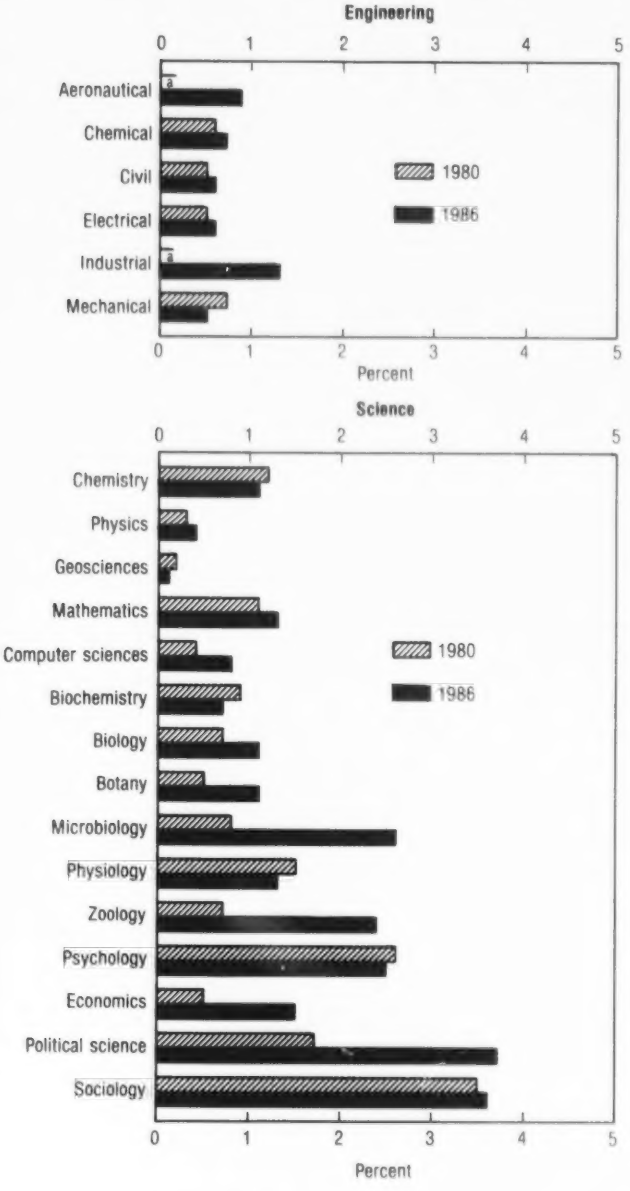
[7]National Science Foundation, *Science and Engineering Doctorates: 1960-85*, *op. cit.*, and "Selected Data on Graduate Science/Engineering Students and Postdoctorates by Sex, Fall 1985" (Washington, D.C., 1986.).

[8]National Science Foundation, *Characteristics of Doctoral Scientists and Engineers in the United States: 1985* (Washington, D.C., 1986).

[9]National Science Foundation, *Science and Engineering Doctorates: 1960-84*, *op. cit.*, and "Selected Data on Graduate Science/Engineering Students, by Racial/Ethnic Background, Fall 1985" (Washington, D.C., 1986.).

[10]*Ibid.*

Chart 3. Black full-time faculty in selected science/engineering departments: 1980 and 1986



[a]Data not available in 1980
SOURCE: National Science Foundation, SRS

to 34 percent in the 6-year period. About 10 percent of the recent-doctorate faculty were Asians in 1986 compared to 7 percent in 1980.

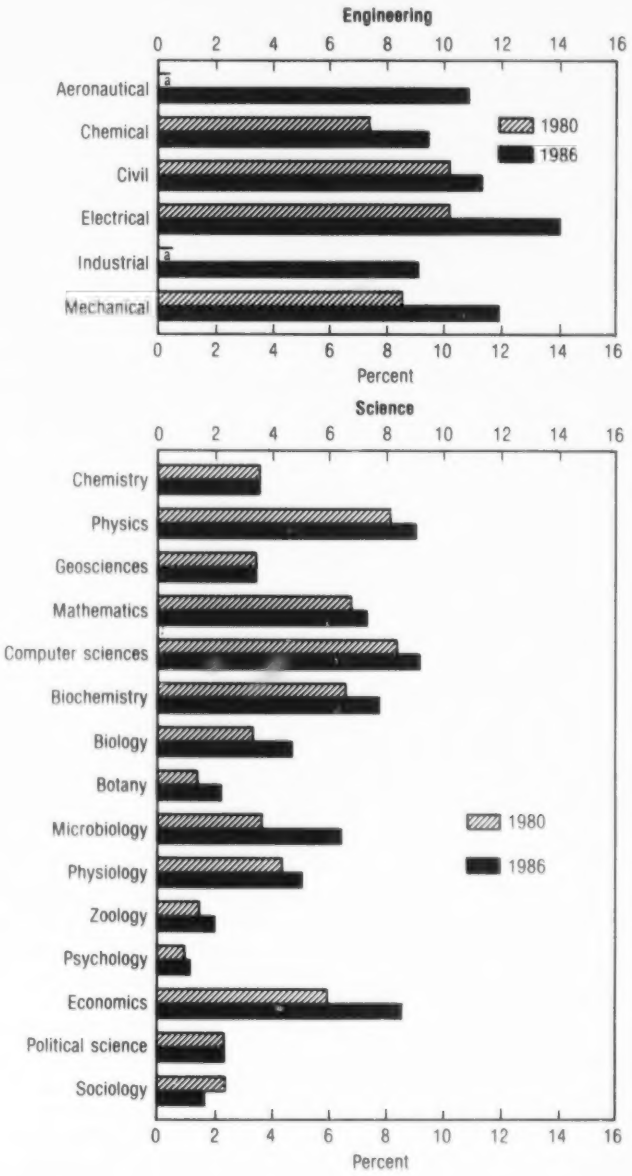
Asians held 7 percent of the faculty positions in 1986 compared to 5 percent in 1980. They held 19 percent of the nonfaculty doctorate positions in both years. These proportions were higher than Asians' share of S/E graduate enrollment and doctorate recipients; i.e., only 3 percent of graduate students in 1985, and 5 percent of recent-doctorate recipients.[11]

[11] *Ibid.*

Compared to whites and other racial minorities, Asians were more likely to hold nonfaculty positions in both 1980 and 1986. Twenty-two percent of the Asians in the S/E departments surveyed in 1986 were nonfaculty doctorates, down from 1980 (28 percent). In contrast, only 1 percent of the blacks, 8 percent of the whites, and 19 percent of the native Americans were nonfaculty doctorates in 1986.

Over a third of the Asian faculty held positions in the six engineering fields surveyed, where they accounted for 12 percent of the faculty in 1986 (chart 4). The highest concentration was in electrical engineering (14 percent) and the smallest was in industrial engineering (9 percent). Asians accounted for 5 percent of the science faculty surveyed in

Chart 4. Asian full-time faculty in selected science/engineering departments: 1980 and 1986



[a]Data not available in 1980
SOURCE: National Science Foundation, SRS

1986; their representation was highest in physics, computer science, and economics, where Asians constituted 9 percent of the faculty. Their representation was lowest in psychology (1 percent). The relative field distribution of Asians may help explain their high median salary of $41,000, comparable to that for whites.[12]

[12]National Science Foundation, *Characteristics of Doctoral Scientists and Engineers in the United States: 1985, op. cit.*

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